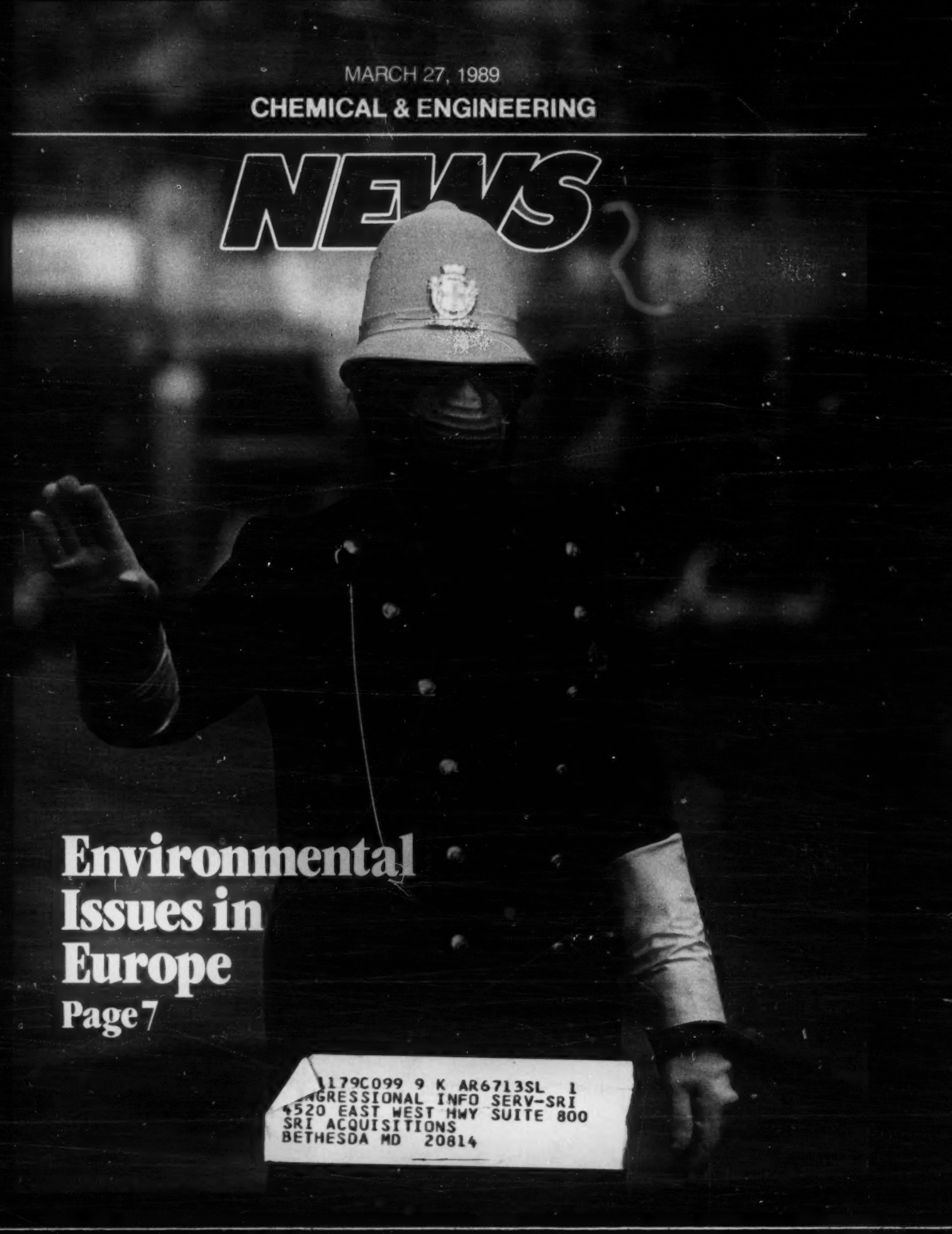
MARCH 27, 1989
CHEMICAL & ENGINEERING

NEWS



Environmental Issues in Europe

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Cover: Traffic policeman in Milan wears mask to protect against air pollution. Photo by Pierre Schwartz/Sipa Press

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LETTERS

Chemical weapons

SIR: The editor of C&EN has correctly pointed out (C&EN, Jan. 16, page 5) that as Vice President, George Bush had spoken in opposition to chemical weapons. At ongoing disarmament talks in Geneva in 1984, he presented a draft treaty that would halt production of chemical weapons. And as President-elect, he had publicly stated that he would like to be the President who was instrumental in ridding the world of chemical and biological weapons. These are indeed welcome words.

We can only hope that with President Bush words will speak louder than actions. On three occasions, when there was a tie vote in the Senate on nerve gases or nerve gas weapons, Vice President Bush cast his vote in favor of the nerve gases. These votes occurred on July 3, 1983; Nov. 8, 1983; and Aug. 7, 1986. Unfortunately, a healthy skepticism is in order.

Thomas Rees
Hamden, Conn.

Portable pensions

SIR: With regard to Attila Pavlath's report on the desirability of portable pensions (C&EN, Dec. 19, 1988, page 45) and Gabriele Wohlauer's excellent letter (C&EN, Jan. 30, page 3), I would like to call attention to another method besides layoffs by which pensions have been drastically reduced without any action or recourse by the employees.

In 1955, I went to work for General Electric at a major Atomic Energy Commission laboratory. A few months short of 10 years later (at that time the GE pension was 0% vested before 10 years), AEC replaced GE as the prime contractor operating the laboratory. Except for less than a half-dozen top managers and administrators, the staff remained the same and became employees of the new contractor. Continuity of service was maintained with regard to vacation and some other relatively minor benefits but not with regard to pension. In my own case, this change of AEC prime contractors did not in any way affect the program I was working on or where I worked (I have had the same laboratory in the same building for 33 years); nor did it change who I reported to for at least two levels of management above me. I was paid a small cash value for my nonvested GE pension, which I immediately rolled over into an annuity set up by AEC for that purpose. As I approach my planned retirement date, it has become clear that my total pension, including the small annuity based on my GE years, will not exceed 70% of what it would have been if one contractor had operated the laboratory for the entire time.

AEC, followed by the Energy Research & Development Administration and later yet by the Department of Energy, has changed contractors at various of their sites, and at some sites several times. It is my understanding that, at least in part of these prime contractor changes, pensions have been better dealt with. I have been told that in the contractor change affecting my pension it was the new contractor who insisted on the arrangement made, but I do not have firm information to either confirm or refute that. Employers have opposed portability of pensions to discourage employees from changing jobs. Although one may or may not agree with that attitude, one can see that it is a valid issue. On the other hand, it is hard to see any valid arguments whatsoever for not fully protecting pensions of those loyal employees caught by involuntary layoffs or by laboratory contractor changes. I feel that ACS and other professional and labor organizations should take a strong stand in whatever ways they can to help to get this situation corrected.

Jack L. Ryan
Richland, Wash.

Fluoridation of water

SIR: Surgeon General C. Everett Koop has asserted there is "no credible evidence of harm that would justify abandonment of fluoridation" (C&EN, Nov. 28, 1988, page 2). Just what kind of evidence he would find convincing is not clear, but he certainly did not offer any scientific grounds to reject unrefuted published findings of clinically demonstrated adverse health effects from fluoridated drinking water, as reported by Bette Hileman in her article on fluoridation (C&EN, Aug. 1, 1988, page 26).

My late husband, George L. Waldbott, M.D., who was nationally and internationally recognized for his extensive research on allergic-type hypersensitivities, devoted more than 25 years to the investigation of toxic effects of fluoride. He proved unequivocally, and other physicians have fully confirmed his findings, that fluoride added to drinking water at the officially recommended concentration of 1 ppm causes serious poisoning in sensitive individuals. In certain instances he conducted blind and even double-blind tests as recom-

NASA makes plans for Earth surveillance

The Earth Observing System (EOS), an ambitious project to monitor global changes in Earth's environment through satellite-based instruments, moved one step closer to reality last week. Some 200 scientists met at the National Aeronautics & Space Administration's Goddard Space Flight Center in Greenbelt, Md., to do some detailed planning for what NASA administrators are describing as "potentially the largest scientific undertaking in the history of spaceflight."

The EOS measurements, which will be taken from platforms circling the globe in polar orbit, are the first part of an even larger program laid out by NASA as "Mission to Planet Earth." The goal of the program is to understand Earth as an integrated system by simultaneously observing the atmosphere, oceans, and land. Scientists will then be able to come up with quantitative predictions for policymakers trying to deal with global change.

"Problems with broad global impact, such as ozone depletion and greenhouse warming, cut across disciplines," says NASA EOS scientist Dixon M. Butler. "Space has a unique role to play in global projects."

Despite its ultimate price tag of $15 billion to $30 billion over 15 years, Mission to Planet Earth has strong Congressional support. Both Sen. Ernest F. Hollings (D.-S.C.), chairman of the Committee on Commerce, Science & Transportation, and Sen. Albert Gore Jr. (D.-Tenn.), chairman of the subcommittee that oversees space programs said in a recent hearing that the program should be a top NASA priority.

Some observers are concerned, however, because current funding for such global observations is tied to the controversial manned space station. Specifically, money for the first EOS polar platform has been allocated under the space-station program, even though the satellite will have no physical or logistical connection to the station. The fear is that the more glamorous manned program could shoulder out the more cost-effective satellite research program. "When the National Research Council reviewed the space-station program about a year and a half ago, it said there is no natural link between the manned base and the satellites and that each should be considered on its own merits," points out Marcia Smith, aerospace policy specialist with the Congressional Research Service.

For now, however, the hardware for the first EOS polar platform is being developed by NASA's office of the space station at an estimated cost of about $400 million with an anticipated launch date of 1996. NASA also plans to build a second polar platform, with two more to be built by the European Space Agency and one by the Japanese Space Development Agency.

Pamela Zurer

Foreigners win almost half of 1988 U.S. patents

Reaching a new peak in a steadily rising trend, foreign firms and inventors last year won close to half the patents awarded by the U.S., according to figures just released by the Patent & Trademark Office.

Of 84,272 patents issued last year, 39,702 or 47.1% went to foreign residents—an increase of 0.5% over the 46.6% foreign portion in 1987 (C&EN, March 7, 1988, page 7). The foreign share is well over double 25 years ago, going from 18.6% in 1963 to 36.7% in 1978 and 45.4% in 1986.

Japan leads foreign countries by far, with 16,984 patents (20.2% of the overall total), up from 19.3% in 1987 and 18.0% in 1986. Its share has doubled in a decade from 10.1% in 1978. Japan replaced West Germany in 1975 as the foreign leader.

West Germany ranks second, with 7501 patents (8.9%). France and the U.K. come next, both with 3.3%. Making its first appearance among the top 10 foreign nations is Taiwan, with 536 patents (0.6%). Its U.S. patents have soared from just 40 (0.06%) in 1978 to 165 (0.2%) in 1985, 269 (0.3%) in 1986, and 411 (0.5%) in 1987. China won only 48 patents in 1988; the U.S.S.R. had 97.

Japan far in lead in gaining U.S. patents

	1988	% 1988	1987
Japan	16,984	20.2%	17,288
West Germany	7,501	8.9	8,030
France	2,792	3.3	2,990
U.K.	2,756	3.3	2,967
Canada	1,642	1.9	1,769
Switzerland	1,298	1.5	1,440
Italy	1,172	1.4	1,285
Netherlands	899	1.1	997
Sweden	891	1.1	1,089
Taiwan	536	0.6	411
Other foreign countries	3,231	3.8	3,408
TOTAL TO FOREIGNERS	39,702	47.1%	41,674
TOTAL ISSUED	84,272	100%	89,385

Source: U.S. Patent & Trademark Office

Five of the top 10 firms winning patents in 1988 are Japanese: Hitachi (1), Toshiba (3), Canon (4), Fuji (5), and Mitsubishi (9). West Germany's Siemens (7) and Bayer (10) and Dutch-owned North American Philips Corp. (6) rank high. General Electric/RCA (2) and IBM (8) are the only U.S.-owned firms on the list.

Figures have not beem compiled for the foreign share of U.S chemically related patents, according to the Chemical Manufacturers Association and other sources. However, the Pharmaceutical Manufacturers Association finds that, similar to the overall trend, foreigners have won about half of U.S. patents on drugs and medicines during the past decade. Japan leads all foreign nations here, too.

The U.S. still has a big lead in biotechnology, however, PMA finds. For example, in 1987 U.S. inventors won 80% of the 199 patents for pharmaceutical and health care products based on genetic engineering.

The latest PTO figures are likely to increase concern over U.S. technological competitiveness. Indeed, PTO's assistant commissioner for patent examining, Rene D. Tegtmeyer, tells C&EN that U.S. firms have had a large, comfortable domestic market, and have been complacent. They have de-emphasized R&D, and neglected to protect themselves with patents.

However, he adds, "In recent years, they've been getting a rude

awakening." Patent applications in the 1980s by U.S. inventors have grown in absolute numbers, although not so fast as foreign filings. Moreover, he now sees signs that things may be turning around. In fiscal 1988, for the first time in many years, the U.S. share of patent applications rose, up to 54.9% from 54.6% in fiscal 1987. The U.S. share hit 55.3% in the first quarter of fiscal 1989, continuing the trend. These are small changes requiring further confirmation, and they will take about 18 months to affect patent issuance figures. But Tegtmeyer considers them "very promising."

Richard Seltzer

Max Tishler, drug pioneer, dead at 82

Max Tishler, 82, who spent his life applying chemistry to fight disease, died of emphysema on March 18 in Middletown, Conn. He was cited in 1987 as "a giant on the chemical scene" when he was awarded the National Medal of Science, the nation's highest scientific honor.

As the former head of Merck Sharp & Dohme Research Laboratories in Rahway, N.J., Tishler led research programs that developed drugs or vaccines for heart disease, hypertension, arthritis, mental depression, and infectious diseases, as well as products to control poultry and livestock diseases.

He led the Merck team that developed a production process for penicillin during World War II, and played a key role in developing processes for vitamins B_2, B_6, K_1 and E; pantothenic acid; biocytin; and nicotinic acid. He helped launch a new era in treatment of inflammatory disease through a process for large-scale production of cortisone.

After 33 years at Merck, Tishler made perhaps the most difficult decision of his life: Eighteen months short of the mandatory retirement age of 65, he accepted a research and teaching post in 1970 at Wesleyan University in Middletown. "I am simply not ready or willing to retire," he said.

Shortly after beginning his "second career" at Wesleyan, Tishler received the American Chemical Society's highest honor, the Priestley Medal. He served as ACS president in 1972.

He later became a university professor emeritus at Wesleyan, where he continued his research on bioactive compounds and got students interested in the field. Peter S. Wharton, an organic chemistry professor at the university, says Tishler "made a tremendous impact on Wesleyan. He brought life and activity to this place."

During his half century at Merck and Wesleyan, Tishler published more than 100 papers and was granted well over 100 U.S. patents. He said he decided to devote his life to relieving the sufferings of the sick when, as an errand boy for a neighborhood pharmacy in his native Boston, he witnessed the ravages of the 1918 flu epidemic.

He received his B.S. degree in chemistry from Tufts University in 1928 and a Ph.D. in organic chemistry from Harvard University in 1934. After three years of working as a research associate and instructor at Harvard, he joined Merck as a bench chemist. He rose rapidly at Merck, serving as a research director, vice president and executive director, president, and finally senior vice president for R&D in 1969.

Ron Dagani

Debate swirls around human genome project

Debate centered on the project to map the human genome as scientists met last week at a symposium in Philadelphia, "The Merging of Chemistry and Biology: Looking Backward/Looking Forward."

The symposium celebrated affiliation of the American Society for Biochemistry & Molecular Biology with the Arnold & Mabel Beckman Center for the History of Chemistry. The center is a joint endeavor of the American Chemical Society, American Institute of Chemical Engineers, and University of Pennsylvania, with the Chemists' Club and the Electrochemical Society also being affiliates.

The project to map the human genome is a "political football" that "has been sold to the public as a phony bill of goods," said Nobel Laureate Joshua Lederberg, president of Rockefeller University. Proponents of the project to sequence the 4 billion base pairs of DNA in human chromosomes argue that the knowledge will reveal all aspects of body structure and function, he says. But the opposite is the case. Scientists will have to analyze human biological functions to understand the DNA sequence. Lederberg predicts that when the public realizes this, there will be "disillusionment" and "a possible backlash."

But biochemistry professor Paul Berg of Stanford University, also a Nobel Laureate, is more optimistic. He notes that the project will begin efficiently by mapping the genome to provide signposts for the later sequencing. This genetic map, which could be ready in two years, will be followed by a physical map to locate certain DNA sequences on chromosomes known to bear genes related to human disease.

Berg says that the complete sequence, when determined, will not be recognizable except where it is most obvious. Biologists will still not know how it all works. Berg suggests that help might come from computer scientists, experienced as they are in logical symbol manipulation and pattern recognition.

Stephen Stinson

Environmental Concerns Gain Prominence in Europe

With flurry of diverse issues ranging from dumping of industrial wastes in landfills to the buildup of noxious gases in urban air, environmental problems have become major factor in policy and trade decisions

Dermot A. O'Sullivan, C&EN London

The Mayor: The point at issue is not a purely scientific one; it is a complex question, with both technical and economic aspects.
Dr. Stockmann: But the source is poisoned, man. Are you mad? We live by trafficking in filth and corruption! The whole life of our flourishing community is founded on a lie!
From "A Public Enemy"

When Norwegian dramatist Henrik Ibsen penned these lines more than 100 years ago in his play that centers on an environmental theme, he unknowingly foreshadowed some of the keen concerns that currently flourish throughout Europe. Hardly a day passes without some mention in the media about such diverse issues as the dumping of municipal and industrial waste in landfills, accidental spillages into major waterways, pollution of bathing beaches by raw sewage effluent, and buildup of noxious gases in urban air reflecting the growing use of automobiles.

Just a few weeks ago, for instance, smog built up in Paris to the point where the stately Eiffel Tower was half hidden from view. And conditions were so bad in Milan that traffic police took to wearing masks.

The problem stemmed from the unusually mild winter throughout much of Western Europe, coupled with an inversion layer that trapped exhaust fumes at ground level. Milan's mayor, Paolo Pillitieri, urged restraint in the use of cars and home heaters. And vehicles without special permits were banned from the city center.

At one point, readings of 431 μg per square meter of sulfur dioxide, and 423 μg per sq m of nitrogen dioxide were recorded in central Milan. The figures far exceed the maximum levels recommended by the environment directorate of the European Community: 250 μg per sq m for sulfur dioxide and 200 μg per sq m for nitrogen dioxide.

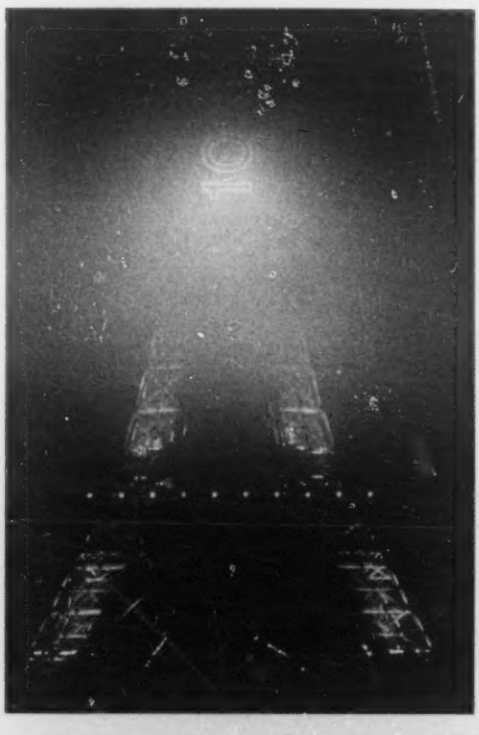


Photo by Pierre Schwartz, Sipa Press

Many international events with environmental themes are being staged in Western Europe. In the opening days of this month was a conference in London titled "Saving the Ozone Layer." Organized at the behest of U.K. Prime Minister Margaret Thatcher, and cohosted by the United Nations Environment Program (UNEP), it served to focus the attention of some 700 senior delegates from 124 countries on the urgency of reducing, and eventually eliminating, use of ozone-depleting chlorofluorocarbons (CFCs) and halons.

In The Hague a few days later, the prime ministers of France, the Netherlands, and Norway jointly held a meeting attended by leaders of 24 countries. They signed a "declaration" promoting five "principles." One urges creation of a "new institutional authority within the framework of the United Nations which shall be responsible for combating further global warming of the atmosphere." Another calls for "appropriate measures to promote the effective implementation of, and compliance

with, decisions of the new authority, which will be subject to control by the International Court of Justice [in The Hague]."

As C&EN was going to press, ministers and high government officials from more than 100 countries were meeting in Basel. They were seeking final agreement on a treaty, drawn up with the help of UNEP, to limit and control international transport and disposal of hazardous waste. And in Helsinki in early May there will be a meeting of signatories of the 1987 Montreal protocol that calls for cuts in output of CFCs and halons.

Even royalty is getting in on the environmental act. Queen Beatrix of the Netherlands devoted her entire annual Christmas speech last year to the subject. "It is encouraging to see people and nations everywhere calling each other and themselves to order," she said. "We face the challenge of finding a new relationship with nature, marked by regard for ecological equilibrium, circumspection, and careful management. We are duty bound to leave our habitat in at least as good a condition as we found it. The quality of life itself transcends the interests that matter in our own temporary lives."

Likewise, the U.K.'s Queen Elizabeth II noted in her annual Commonwealth Day message this month that "Concern for the resources we share in common means partnership not only across oceans, but also between generations." And her son, Prince Charles, in a no-nonsense address to those who attended the ozone-saving conference, observed that "The seas are fast becoming sewers. We make poisons so powerful we don't know where to put them. Rain forests are being turned into deserts. If we can stop the sky turning into a microwave oven, we still face the prospect of living in a garbage dump."

Thatcher caused some raised eyebrows at her after-dinner talk last fall to the Royal Society in London in which she devoted a considerable portion to environmental issues. Noting specifically the greenhouse effect, the hole in the Antarctic ozone layer, and acid rain, she said, "In the past, when we have identified forms of pollution, we have shown our capacity to act effectively. Even though this kind of action may cost a lot, I believe it to be money well and necessarily spent, because the health of the economy and the health of the environment are totally dependent upon each other."

Media pundits and environmentalists, referring to what they see as "The greening of Mrs. T," make the point that during her 10 years in office, her government's record on environmental issues leaves much to be desired. Indeed, Britain's all-party Environment Committee attached to the House of Commons takes the U.K. to task in a just-published, strongly worded report dealing with municipal and industrial waste.

Referring to dumps and landfill sites throughout the country, Sir Hugh Rossi, who chairs the committee, says: "No one knows what's in them. God knows what kind of time bomb we are sitting on. It is little short of a miracle that we have not had disasters from the escape of poisons into our water supplies, or from gas explosions, although we have come perilously close to it."

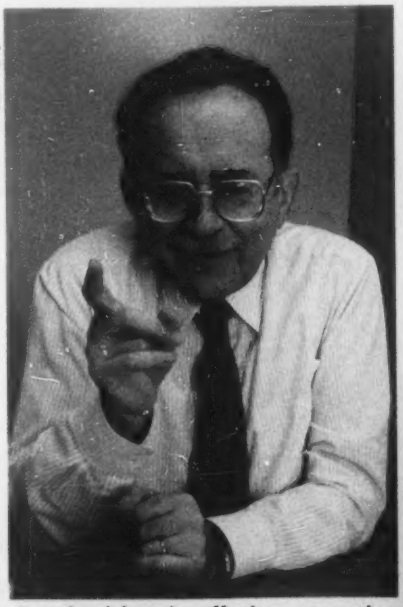
The treatment and safe disposal of waste, both solid and liquid, is big business in Europe. Each year, about 2 billion tons of waste of all kinds are generated by the 12 member countries of the European Community alone. Industrial waste in those countries accounts for an estimated 160 million tons, of which up to 30 million tons is classed as toxic or dangerous. Most of this problem waste comes from the chemical industry. Its handling entails considerable technical expertise.

Waste associations of Belgium, France, West Germany, Italy, the Netherlands, Spain, and the U.K. now are linked through the European Federation of Special Waste Industries (CEADS). Corresponding bodies from other European countries may join following CEADS's first general assembly next month in Brussels.

Says CEADS executive director Rolf Eder at its Bonn headquarters: "Our members are active in all areas of waste treatment—incineration, distillation, recycling, recovery, and so on."

One of the organization's functions is to disseminate information pertinent to its members. For example, it provides a forum for discussion of new and improved techniques. Also, it keeps abreast of waste-related legislation in various countries, and of developments emerging from international bodies such as the Organization for Economic Cooperation & Development (OECD) and UNEP. It also provides

C&EN staff photos



Jourdan (above): pollution prevention pays. Klatte: group condemns burning of waste in North Sea

a liaison with CEFIC, the European Chemical Industry Federation, although it is separate from it.

CEFIC's Louis Jourdan, the organization's director of technical affairs, points out that the federation has been closely involved for a number of years in the many aspects of environmental issues as they relate to the chemical industry. Responding to a widespread perception that waste, especially that coming from the chemical industry, is a threat to health and the environment, a 12-member CEFIC industrial waste management task force drawn from representatives of the leading European chemical companies meets regularly to maintain an overview of the situation and formulate codes of practice.

"Much play has been given to the 'Polluter Pays Principle' coined some years ago," Jourdan observes. "But it is equally true that the public pays for pollution, and that pollution prevention pays. This is the message I try to get across. The savings a company makes in running its operations cleanly and with the minimum of waste that must be disposed of can be passed on to the customer. The resulting lower-cost products will be favored in the marketplace over those of competitors."

What to do with the waste that does accumulate is a problem, nevertheless. Some goes for incineration out in the North Sea. But many condemn the practice because of the harm it may do to the marine environment. Ernst R. Klatte, who heads Greenpeace International's Brussels office, points to a position paper his group has drawn up claiming that more than 100,000 tons of waste is incinerated each year in the North Sea, over half of it coming from West Germany. "We are preparing now for the third North Sea Conference [a regular meeting of representatives from countries bordering the North Sea] planned for The Hague next year when this, and other issues, will be discussed at length," he notes. Acknowledging the concern, the U.N. International Maritime Organization based in London is taking steps that could lead to a ban on North Sea burning after 1994.

Some countries have resorted to shipping waste for dumping in developing countries, many on the west coast of Africa, that are ill equipped to cope with it. This caused something of an international furor last year when such cargos were found to have been surreptitiously off-loaded in Nigeria and elsewhere. Some European countries are legislating bans on such shipments. And the practice would be curtailed further if the UNEP-inspired treaty is adopted.

Several European countries operate collection systems for chemical waste from households and small industries. In the Netherlands, for example, specially designed Chemocar trucks move through communities at regular intervals to pick up and take away such products as paints, solvents, and motor oils for disposal in supervised facilities in much the same way that paper and glass are collected.

Denmark has had a chemical waste incineration program since 1975. The Kommunekemi treatment plant, operated under license from the National Agency of Environmental Protection, is sited at Nyborg on Funen Island. Two furnaces cope with about 100,000 metric tons annually of organic and oily waste. A third nearing completion will help in disposing of what is expected to reach some 150,000 metric tons per year.

Combustion and destruction efficiencies are extremely high, well above 99%, claims Albert S. Welinder of the environment protection agency. But he admits that the planning process for the new incinerator line "has been long and tedious, involving political decisions in the local council for more than a year, with the focus on factors of a psychological, rather than a physicochemical, nature. Clearly, further increases at Nyborg are not acceptable."

The 540 municipal incinerators throughout the EC dispose of about a quarter of the member countries' waste each year. Moves now are afoot that, if adopted, will standardize gaseous emission measuring systems, and set limits on the quantities of chemicals that may be released into the atmosphere. Those being considered include hydrochloric and hydrofluoric acids, dioxins and furans, sulfur dioxide, and heavy metals.

Although incineration plays an important role in the removal of waste, the plants and their operators are subject to frequent criticism and rebuke by those who happen to live near them. Any plans for expanding the system, or installing

In Netherlands, special trucks pick up paints, oils, other products for disposal

new facilities, usually evoke strong opposition.

"Here, we get into the not-in-my-backyard, or NIMBY, syndrome," comments Edward Bennett, director of nuclear safety, waste management, and the prevention and control of chemical pollution at the EC's environment directorate in Brussels. "It is a problem for any high-tech plant for the treatment of waste. People say, 'We recognize the need, but put it somewhere else.' "

It was partly to sharpen people's awareness of the need for protecting their environment, and partly to publicize measures toward achieving this end, that the EC organized its European Year of the Environment, which ended March 20 last year. With considerable hype, member countries arranged shows and demonstrations, produced videos and reading material, planned guided walks in the countryside, held contests, and gave awards to "clean" industries. Chemical companies heartily endorsed the event and provided support to the programs.

The legal means of safeguarding the environment throughout the EC is by directives prepared by the 12-member council of environment ministers, drawn from each of the member states, following proposals from the EC Commission. When a directive is adopted, it goes through the parliamentary processes in each member country before it becomes an EC law. Parties that don't abide by the rules laid down could ultimately be brought before the European Court of Justice in Luxembourg.

There are other routes to environmental improvement. For example, in addition to strictly national programs, the EC provides funding for various types of studies, including research into developing cleaner industrial processes, recycling, and the like. Another is through formal, four-year EC environmental action programs.

Earlier this month, Carlo Ripa di Meana, the recently appointed EC Environment Commissioner, spoke of plans for setting up a European Environment Agency. This would be an independent body with a networking and coordinating role. Among its objectives would be linking the work of existing EC institutions with that of the European Space Agency, and examining the interplay between environmental considerations and broader economic factors.

Greenpeace/Van Der Veer photo

Incinerator ship **Vesta** *burning waste in North Sea*

In addition, there is what's known as the Single European Act adopted in July 1987. It is the first amendment of the 1957 Treaty of Rome, which enshrines the basic principles of EC law. The Single Act, as it is more generally known, gives environment politics a European dimension, as one observer puts it.

"For the first time in the treaties of the EC there is specific reference to environmental objectives," Bennett points out. "These are to preserve, protect, and improve the quality of the environment; to contribute toward protecting human health; and to ensure prudent and rational utilization of natural resources. The act makes provision for greater use of a system of majority voting within the EC's Council of Ministers to speed decision-making on environmental issues. This should assist us toward establishing a comprehensive framework for European environmental policy."

The Danish government set the proverbial cat among the pigeons in Brussels when it made a ruling that beer and soft drinks sold throughout the country must be supplied in returnable—namely, glass—bottles. The move, the Danes maintain, is to cut down on the amount of plastic waste and metal cans to be disposed of. But there were those in neighboring EC countries, and in the EC Commission, who saw it as a restriction on the free movement of goods, and a means of protecting Danish brewers' share of the home market. They also pointed to the fact that Danish brewers sell products on the export market in the type of one-way containers they are banning.

The upshot was that Denmark was charged with breach of the rules of the Rome Treaty, and brought before the European Court of Justice. It was the first such case to be tried since implementation of the Single Act. But to the surprise and dismay of many, the court came down broadly in favor of the Danes. The reasoning was that countries may take unilateral action on the basis of protecting their environment. West Germany has since taken a step in the same direction by imposing a mandatory deposit fee on plastic containers for all kinds of drinks. The deposit is high in relation to the selling price of the products.

One body concerned by the development is the Association of Plastics Manufacturers in Europe. Comments Peter G. Claus, APME's director in Brussels, "The West German decree will cause serious barriers to trade because of the high cost for exporters to the West German market in taking back empty containers. It will especially affect trade in mineral water that according to an EC directive on product purity must be bottled at source. The water cannot be transported in bulk for bottling in West Germany."

The government of the Nether-

lands, too, is causing a stir among EC officialdom by providing fiscal incentives to buyers of small and medium-size cars fitted with catalytic converters that clean the exhaust gas to U.S. standards. The U.S. standards are more stringent than those the EC adopted in November, and which go into force early next year. Here again the European Court of Justice is being asked to make a ruling on the issue, but that could take the best part of two years. Meanwhile, there's talk in Denmark and West Germany about moving to encourage purchase of cleaner cars. Greece plans tax incentives for cars that run on unleaded gasoline, and the U.K. has just introduced preferential pricing on unleaded fuel along the lines of policies in most other EC countries.

Opposition to the Dutch move comes mainly from car makers in France on the argument that "the whole [auto emissions] harmonization system in the EC risks tearing apart." But as Raymond Van Ermen, secretary general of the European Environmental Bureau in Brussels, sees it, "We cannot accept a system in which EC car makers produce cars that can meet the U.S. standards, but reserve them for export outside the EC.

"There are three levels of auto emission standards. The most lenient is that of the EC. The toughest is the U.S. Intermediate between the two is the standard of the European Free Trade Assocation (EFTA) countries. We in the EC are being treated as second-class citizens. In Austria, Switzerland, and elsewhere, you find cars made by well-known EC companies that respect U.S. and EFTA standards. So why not here?"

He adds that the European Environmental Bureau (EEB), which was set up in 1974 and to which 120 environment-related nongovernmental organizations within the EC belong, awarded its annual booby prize last year to Jacques Calvet, managing director of the French Peugeot, Talbot, and Citroën line of cars. "Mr. Calvet," the citation reads, "is head of a business that does not understand that the dynamism for protecting the environment is a part of management and the public image of a business."

C&EN staff photo

Bennett: not-in-my-backyard reaction

"The EC Commission," Van Ermen maintains, "takes the approach that environmental standards should be considered as a ceiling, a maximum, and the states should not be allowed to seek stronger measures. The other view, which EEB fosters, is that the standards serve as a floor, or minimum, with states able to use initiatives to achieve stricter environment policies."

The EC's first environmental directive relating to water was issued toward the close of 1973. It centered on "hard" detergents that, because of their persistence, were causing widespread problems to sewage-treatment plants. And, in addition to impairing oxygenation and photosynthesis, they produced unsightly foaming. Interestingly, it wasn't until almost 10 years later that a directive presenting quality standards of drinking water became effective. And it was in December 1985 that all discharges into groundwater, the source of about 70% of drinking water throughout the EC, had to be controlled.

Breach of drinking water directives, nevertheless, seemingly is common. The EC Commission recently has leveled criticism, and in some cases taken legal action, against Belgium, Denmark, France, West Germany, Italy, Ireland, the Netherlands, Spain, and the U.K. Likewise, the commission isn't pleased with the condition of many of the beaches that have been officially designated as swimming areas. Untreated sewage and other filth wash around the shores of some of the most popular vacation spots.

During the closing weeks of last year, scientists from seven EC countries aboard the *Discovery*, a 2100-ton research vessel owned and operated by the U.K.'s National Environment Research Council, sampled water, sediments, and biota in the Mediterranean Sea off the Rhône delta in southern France. The study was the first of a series planned under the EROS (for European River Ocean System) 2000 project. This is a long-term, multidisciplinary research program, supported by the EC and drawing on help from 25 institutions in 11 member countries, to chart river and atmospheric pollution of the EC coastline. Its aim is to enable better management of European seas and their biological resources.

It will take several months to complete analysis and interpretation of the 900 million or so data readings taken during the four-week cruise. But there are early indications of elevated concentrations of such nutrients as nitrates and phosphates

C&EN staff photo

Claus: serious barriers to trade

near the mouth of the Rhône and extending out to sea. Also, the role of certain microorganisms in the adsorption and breakdown of pollutants has been identified.

Subtle changes in the marine environment seemingly can give rise to unusual and sometimes serious consequences. This occured last summer when a planktonic algal bloom consisting of large quantities of *Chrysochromulina polylepis*, a single-cell flagellate, developed spontaneously in the sea between Denmark and Sweden. The carpet of algae was carried by currents westward along Norway's southern coastline. Because the alga produces a toxin that kills a variety of sea life, it resulted in damage and economic harm to the fish-farming operations in the region.

The toxin is a glycolipid similar to that found in *Prymnesium parvum*, to which *Chrysochromulina polylepis* is related. It functions by destroying cell membranes, and bringing about paralysis of infected organisms.

The bloom persisted for about four weeks in May and June before dissipating south of Bergen on Norway's west coast. At its height, cell counts of 80 million or more per liter of seawater were recorded. Mortality and damage to marine biota were registered from the surface down to a maximum depth of some 100 feet.

Analysis of seawater nutrients registered a rise above the more usual level of nitrate and a fall in silicate. "The contention is that this contributed to the situation," remarks John A. Berge of the Norwegian Institute for Water Research (NIVA) in Oslo, who with his colleagues there and scientists from a number of other facilities in Norway and Sweden, closely monitored and evaluated the occurrence.

"The explanation for the bloom centers on the nutrients," Berge says. "Where these came from is a matter of speculation.

"There has been a lot of documentation on previous algal blooms, but not on one of this particular [toxic] organism. If it is the case that this bloom marks the commencement of a period with more frequent blooms of toxic algae such as Chrysochromulina, the result in the long term may be the depletion of both algal and animal coastal communities."

It's considered unlikely that the toxic algal bloom was directly responsible for last year's widespread death of seals along the coasts of countries bordering the North Sea. Mortality among the seal population has been attributed to a virus akin to that which causes distemper in dogs. It might well be, however, that ingestion of the algae weakened the seals' resistance to the viral infection.

Although the biota of Norway's fjords escaped the worst of the Chrysochromulina threat, they remain prone to the ravages of industrial pollution. Jens Skei, a marine geochemist at NIVA, is at the forefront of a series of research projects evaluating the environmental damage by effluents from a variety of processes.

The fjords, so characteristic of Norway's coastline, are long, narrow, steep-sided sea inlets cut by glaciers thousands of years ago. Many industrial operations have been sited at the head of the fjords to take advantage of relatively inexpensive hydroelectric power generated by water coming down from the mountains. "They can create pollution problems," Skei points out, "because effluents enter the water far from the open sea where there is very little dilution, unlike the river estuaries in other countries."

An example is the 120,000 metric-ton-a-year electrolytic zinc operation of Norzink at Odda at the head of Sørfjord to the east of Bergen. Dating from 1929, the company is jointly owned by Sweden's Boliden and BP Minerals. (British Petroleum currently is negotiating sale of BP Minerals to RTZ, which presumably will acquire the half-share interest in Norzink if the sale goes through).

"We found the bay stuffed with very high levels of such heavy metals as zinc, lead, copper, mercury, cadmium, and the like," Skei says. "Much of it had been dumped as solid waste creating enormous problems to the water quality and biota."

Partially as a result of the NIVA findings, Norzink has stopped putting the waste in the fjord. Instead, the company is depositing it in tunnels bored into the neighboring mountain at considerable expense.

Burying of waste also has resulted from studies Skei and his associates made of a titanium dioxide facility

C&EN staff photos

Van Ermen (left): environmental rules should be considered as a ceiling. Johannessen: nitrogen level is up

at Frederikstad on the seacoast, due south of Oslo. Belonging to Kronos Titan, owned by NL Industries, the facility has an annual capacity of 25,000 metric tons and uses the sulfate process.

Until recently, the red-colored acidic waste was discharged into the adjacent Glomma River at a depth of about 20 feet. The heavy metals content of the effluent and its high degree of acidity had an impact on the region's fish life and marine biota. So much so that Kronos-Titan decided last May to pump the effluent into barges for shipment to a disused calcite mine in the Oslo fjord into which the waste is dumped.

Operations of Norsk Hydro, Norway's largest producer of chemicals, also came under Skei's scrutiny. One involved the discharge from a mercury cell chlor-alkali plant. Another centered on effluent from a unit that extracts magnesium from seawater. Both have been in service for the past 40 years or so at Porsgrunn on the Frierfjord, southwest of Oslo. The government imposed a fishing ban in the fjord because of the high level of toxic chemicals there.

"Some 40 metric tons or so of mercury had accumulated in the ground near the chlor-alkali plant. It was contaminating the groundwater, and there was some seepage into the fjord," he recalls. "In the bed of the fjord itself adjacent to the plant, there was a buildup of about 25 metric tons of mercury. Coming from the magnesium unit was an incredible cocktail of toxic chlorinated hydrocarbons, consisting of penta- and hexachlorobenzene, octachlorostyrene, decachlorobiphenyl, and the like, together with dioxins."

The chlor-alkali plant is now shut down. And an effluent treatment system is being installed at the magnesium plant that will reduce the outflow of chlorinated hydrocarbons 90% from the current annual level of about 250 kg. Yearly discharge of dioxins will be cut from 25 g to around 5 g.

"Such studies usually are carried out at the behest of the Norwegian State Pollution Control Authority or the corresponding local bodies," explains Merete Johannessen, NIVA's director of research. NIVA staff members are free to publish their findings and discuss them at scientific meetings, she adds. Moreover, the results can be the basis of Norwegian and, at times, international action on environmental issues. NIVA also serves as the coordinating center for the United Nations Economic Commission for Europe's (UNECE) international cooperation program on assessment and monitoring of acidification of rivers and lakes.

Established by the state 30 years ago, NIVA since has severed its ties with the government and now functions as an independent, autonomous foundation. Still, up to 90% of its annual funding stems from government-related work. "We are directly involved with the use and protection both of Norway's fresh water and of marine water close to the coast," Johannessen notes.

She points to a recently completed survey of water quality in 1000 lakes throughout the country. "We found that the degree of acidity is about the same as it was in a similar survey made 10 years ago, in some cases showing pH values below 5. Sulfate ion concentration has come down, mainly due to lower levels of sulfur deposition. But we have identified an upward shift in the concentration of nitrate ions in the water. Seemingly greater quantities of nitrogen-containing compounds are being leached out of the catchment areas. The shift of anions from sulfate to nitrate maintains the pH of the lake water at the same low levels as before."

NIVA staff members maintain close liaison with their counterparts at the Norwegian Institute for Air Research, or NILU. There, Harald Dovland heads the Chemical Coordinating Center for a multinational air quality monitoring program within the Convention on Long-

Outside sources provide significant amounts of local nitrogen, sulfur depositions

How to read:

Belgium N 25 88%
S 100 55%

Average annual deposition of nitrogen and sulfur (thousands of metric tons) and percentage of deposition received from other countries.

Source: United Nations Economic Commission for Europe, European Monitoring & Evaluation Program

Gibbard's view

Stand clear! I need only five years to sort out all the problems of the world!
Or, perhaps six years...
But I must be able to rest on the seventh!
GREEN
GREEN
GREEN
SAVE OUR PLANET
Manchester Guardian

Enter the Green Goddess

One British cartoonist's view of Margaret Thatcher's pronouncements on environmental issues

Range Transboundary Air Pollution, drawn up under the aegis of the Geneva-based UNECE.

Signed 10 years ago by 34 countries—and the European Community as a bloc—that extend from Canada and the U.S. to the Soviet Union, the convention entered into effect in 1983 when a sufficient number of signatories had ratified it. It aims to "limit and, as far as possible, gradually reduce and prevent air pollution, including long-range transboundary air pollution."

A protocol to the convention adopted by 21 of the countries four years ago calls for a reduction by 1993 of sulfur dioxide in the air 30% below the 1980 emission level. And at last November's annual session held in Sofia, Bulgaria, another protocol was signed that has as its goal a reduction of nitrogen oxides to their 1987 levels by 1994. In addition, 12 countries signed a formal declaration committing them to a 30% reduction of NO_x emissions by 1998.

Within UNECE's European Monitoring & Evaluation Program, measurements have been taken for a number of years of airborne sulfur dioxide and sulfates, together with pH values and concentrations of major ions (ammonium, calcium, magnesium, sodium, chloride, and nitrate) of rainwater. The data are recorded at 95 monitoring stations throughout 24 European countries. More recently, analyses at some of these stations have embraced nitrogen dioxide and other nitrogen compounds in the air, as well as ozone.

Models of the weather conditions throughout Europe, which are continually being refined, have been drawn up at UNECE's two Meteorological Synthesizing Centers. The one responsible for Eastern Europe is at the Institute for Applied Geophysics in Moscow. That for Western Europe is located at Oslo's Meteorological Institute.

NILU's Dovland makes regular checks to ensure that the performance of participating laboratories is within specified standards. He also receives and collates the analytical data, and examines how they compare with what would have been anticipated from the meteorological models. Meanwhile, Anton Eliassen, research head at the Norwegian Meteorological Institute, looks at what the models indicate should have been deposited against actual deposition readings.

"The job is becoming very resource-demanding," Eliassen admits. "It takes more than an hour to integrate the information on the powerful Cray X/MP dual-processing supercomputer at Trondheim University that we are linked with. Indications are encouraging as far as airborne sulfur is concerned. Our calculations show that a reduction already is occurring," he says.

Jan Nilsson at the research and development department of Sweden's National Environmental Protection Board in Stockholm agrees that "Sulfur emissions and annual depositions are decreasing to some extent. We now have the 30% sulfur dioxide reduction agreement. A few countries aim for a greater decrease. Here in Sweden, the goal is a 65% cutback from the 1980 average."

On the other hand, Nilsson sees the acid rain problem in Western Europe, which is blamed partly on airborne sulfur oxides, to be "as big as ever it was. To some extent the reason for the recovery of the forests, or rather the halt in their decline, is that the climate has been so favorable for tree growth in the past few years. But the next time there's a climatic stress factor, such as a hot, dry summer, we will have another breakout of forest damage."

Nilsson is actively promoting the critical load concept, as he calls it. Indeed, by his own admission, he is "the mother and father of it." Simply put, the critical load factor is the load of acid deposition per acre below which no adverse effect on the ecosystem would be expected, even in the long term. The factor varies from region to region and from one chemical species to another.

A year ago, Nilsson helped organize a meeting in Sweden, cosponsored by UNECE and the Nordic Council, to which 16 of the countries that are party to the Convention on Long-Range Transboundary Air Pollution sent specialists. The 72 participants proposed "best estimates" based on current knowledge for critical loads for sulfur in forest soils and groundwater, for nitrogen in terrestrial ecosystems, and for sulfur and nitrogen in surface water systems. They also discussed the biological consequences of an excess nitrogen load to terrestrial ecosystems.

At last November's transboundary convention gathering in Sofia, environment ministers agreed that the critical load concept should be the

Dean and Chapter of Lincoln photo

Effects of atmospheric pollutants on the stonework of this grotesque that decorates Lincoln Cathedral in England are very evident

main basis for negotiations on emission control strategies. Arising from this, work is under way to draw up a manual explaining how to map for critical loads. "We hope that all the countries in the convention will do such mapping," Nilsson comments. "In this way, science will become a very important part of the policy-making process using ecosystem effects as a base, not just economics."

Nilsson expresses concern about the level of airborne nitrogen compounds, which he doesn't see decreasing in the near term. Besides, he adds, one of the key aspects of the critical load concept as it relates to nitrogen is the long-term accumulated amount of nitrogen in a given ecosystem rather than the actual amount deposited over a specific year. "Nitrogen-related damage might not show up for many years," he says. "We see nitrogen accumulation—whether as nitrate, or ammonia, or whatever—as one of the key environmental issues."

Also under the UNECE banner, a Europe-wide experiment got under way last year to assess the effect of air quality on crops. "We are starting out with the Cherry Belle radish, a variety particularly susceptible to damage from ozone," says Mike H. Unsworth, professor of environmental physics at Nottingham University in the U.K. who is coordinating the study. In 12 field sites participating in the project, the plants are grown under identical conditions, and the makeup of the air is continually monitored.

Half the plants at each station are watered with a solution of ethylene diurea, a Du Pont experimental chemical that protects against oxidants. Plants so treated should withstand high ozone levels in the air better than those that are not.

"Radishes are hardly a crop vital to most communities," Unsworth comments. "But they could well serve as an ozone marker."

With input provided by Patricia Irving, assistant director of the National Acid Precipitation Program in Washington, who has been engaged in similar experiments, 10 countries—Czechoslovakia, Finland, France, Italy, the Netherlands, Poland, Spain, Sweden, the U.K., and the U.S.—are taking part in the project. But Unsworth believes others will join as it proceeds.

Such multinational efforts centering on technical aspects of environmental problems are a counterpart to those involving political conferences aimed at treaties and conventions. Together, such activities illustrate the complexity of the issues, as noted by Ibsen's mayor, and are one indication that, with pollution readily crossing national boundaries, national go-it-alone attitudes toward the environment are changing. □

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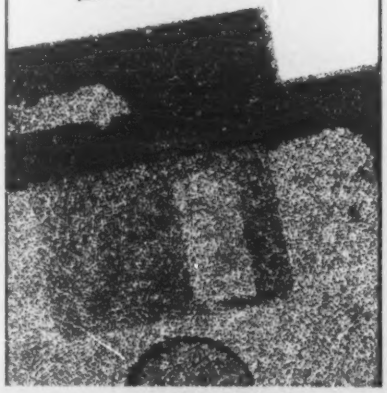


EPA Urges Nations To Limit Greenhouse Gases, Protect Climate

Report to Congress provides a variety of policy options for U.S., international community to delay or lessen expected global warming

If Earth's climate is to be stabilized, governments must act to limit the buildup of greenhouse gases, says a draft report prepared for Congress by the Environmental Protection Agency. Policies ranging from fees on fossil fuels to preserving tropical forests could delay or lessen the global warming expected from the changing composition of the atmosphere, the report concludes.

Furthermore, action by the U.S. or even the industrialized world working in concert will not be sufficient to protect climate. All nations, including developing countries, must limit greenhouse gas emissions.

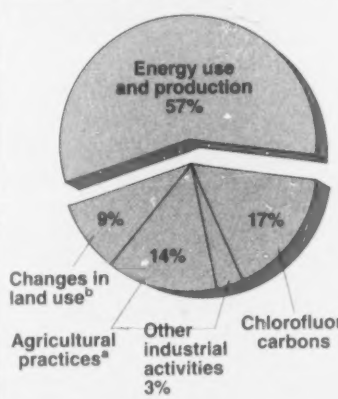
About two years ago, the Senate Committee on Environment & Public Works assigned EPA the monumental task of assessing what policies could stabilize current levels of greenhouse gases like carbon dioxide, methane, and chlorofluorocarbons (CFCs). The resulting report, "Policy Options for Stabilizing Global Climate," presents a diverse series of strategies that could be adopted not only by EPA and other U.S. government agencies but also by the international community.

Although not yet in final form, the draft report is already receiving high marks from researchers and decisionmakers concerned about climate change. "The report is the best systematic effort ever into what options are available," says John C. Topping Jr., president of the Washington, D.C.-based Climate Institute. "It will be the premier document in the field for the next few years."

By flatly stating that the scientific community agrees that significant global warming caused by greenhouse gas emissions will occur throughout the next century, the report bypasses much of the current wrangling about whether greenhouse warming is already upon us (C&EN, March 13, page 25). It also avoids debates over how rapidly and how large a climate change will occur. Instead, the report uses state-of-the-art models to project what the world will be like under several scenarios.

A wide range of policy options are available to significantly slow the rate of greenhouse gas buildup and climate change, the report concludes. Among the steps the report suggests governments could take to cut emissions of greenhouse gases are the following:

Worldwide, energy use dominates global warming



Note: Each activities' contribution to greenhouse warming for the 1980s is estimated based on its share of greenhouse-gas emissions. **a** Includes methane emissions from animals, rice cultivation, and use of nitrogenous fertilizer. **b** Includes deforestation and biomass burning. **Source:** Environmental Protection Agency

- Impose emissions fees on fossil fuels such as oil, coal, and natural gas so that their prices reflect the risk of climate change. Such fees could encourage shifts to other energy sources and also raise funds to finance other programs.
- Require auto fuel efficiency to increase to 50 miles per gal (mpg) or more. Currently, new cars in the U.S. average 25 to 33 mpg.
- Cut residential and commercial energy use by improving building shells; lighting, heating, and cooling equipment; and appliances.
- Step up research on nonfossil fuel energy technologies, including solar, biomass, hydroelectric, geothermal, and nuclear energy.
- Phase out production of CFCs and halons. The 50% cutback of CFC output called for in the Montreal Protocol on Substances That Deplete the Ozone Layer is insufficient.
- Halt clearing of tropical forests and plant more trees. If current trends continue, most tropical forests could be lost during the next century.
- Encourage research into agricultural techniques, such as feed additives for cattle and water management in rice production that could reduce emissions of methane.

Government policies also could make the greenhouse effect worse, the report points out. For instance, a policy to accelerate the development of synthetic oil and gas from coal could hinder conversion to nonfossil fuels.

International cooperation is essential to head off climate change, the report stresses—especially from developing countries. Although per capita emissions in developing countries are now very low compared with the U.S., Europe, Japan, and East bloc nations, the capacity for growth is much larger.

"If the developing countries don't

CO_2 may be increasing faster than EPA assumes

For years, carbon dioxide levels in the atmosphere have been growing about 1.5 ppm per year. However, that increase represents only about half of the carbon dioxide that is emitted to the atmosphere each year—the rest is absorbed by the oceans or the biosphere or both.

Now, however, some scientists are worried that the percentage of carbon dioxide that becomes airborne is increasing. If that turns out to be the case, the kinds of global climate changes that modelers are predicting for the future will occur more quickly than is now predicted.

"The carbon dioxide growth rate for 1987 and 1988 is the highest we've ever seen," says Pieter Tans, a physicist with the University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES). Tans works with data collected by the National Oceanic & Atmospheric Administration's global monitoring for climate change program.

For the past two years, the network has recorded a yearly increase in atmospheric carbon dioxide of about 2.5 ppm. Tans points out that this accelerated rate of increase could be temporary: Two years is not long enough to establish a trend. If it is real, however, it can't be accounted for by increases in the burning of fossil fuels. "Something else is varying," Tans says.

What that something else is remains unclear. The oceans may be absorbing less carbon dioxide or there may be a change going on in terrestrial ecosystems. To sort out just what is shifting, additional information about the many sources and sinks of carbon dioxide is needed.

"It's important that there be precise measurements of carbon dioxide all over the world," says C. David Keeling of Scripps Institution of Oceanography, which is part of the University of California, San Diego. Keeling heads a group that has been continually measuring carbon dioxide in the atmosphere since the 1950s. His researchers not only measure the abundance of carbon dioxide but also make isotopic measurements that indicate whether the gas is coming from land or the oceans.

In the meantime, the apparent change in the carbon dioxide growth rate is making many people nervous. "Hopefully, this is an anomaly," says Climate Institute president John C. Topping Jr. "There could be devastating consequences for Earth if, say, 70% of CO_2 emissions are becoming airborne instead of 50%."

buy in early to the idea that emissions should be reduced, what the industrialized world does will hardly matter," Topping says. "We have to get involved in a serious effort to make technology available so that there doesn't have to be a tradeoff between economic development and protecting the climate."

Topping believes developing countries will be more willing to participate in measures to control emissions of greenhouse gases if they perceive such action as in their interest. It is in Third World countries, he says, where the human toll of drought or coastal flooding brought about by climate change is most likely to be exacted.

"As a practical matter, people aren't going to starve to death here," Topping says. "But it is possible in marginal agricultural-based societies." He suggests the U.S. invest—perhaps through the United Nations Environment Program—in funding studies by scholars in developing nations of the likely local impacts of climate change.

Reducing greenhouse gas emissions can serve other desirable goals in industralized nations, too, the EPA report points out. For example, phasing out CFCs will also serve to protect Earth's deteriorating ozone layer (C&EN, March 13, page 4). And acid rain and dependence on imported oil could be lessened by policies that encourage a switch away from fossil fuels.

The draft report is now under review by EPA's science advisory board. Once revised and finalized, probably sometime in April, it will be sent to Congress—where global climate change is already a hot item on the legislative agenda.

Pamela Zurer

U.S. vexed by spread of chemical weapons

The thorny issue of chemical weapons proliferation is getting thornier. Recently it became public that a Swiss company had supplied Egypt with equipment for a plant that could be used to make chemical weapons. Iran has contacted the same Swiss engineering firm, seeking equipment to build a plant capable of producing phosphorus pentasulfide, a worrisome chemical.

The U.S. is in a bind. It has assumed a major role in stemming the global spread of chemical arms, and was quite vocal when Libya received Western aid to build an alleged chemical weapons plant. Now Egypt appears to be getting the same kind of Western help. But, unlike Libya, Egypt is the U.S.'s major Arab ally in the Mideast, the recipient of more than $2 billion in U.S. military and economic aid this year.

The U.S. has been noticeably less vociferous about the Egyptian acquisition. Although the Swiss Foreign Ministry acknowledges that the plant was intended to make chemical weapons, the U.S. has not called for the dismantling of the Egyptian plant as it did for the Libyan one.

In fact, the U.S. has deflected the Egyptian affair slightly by focusing on the Swiss-Iran link and by calling for an international conference on proliferation. The call for a conference came in Vienna in early March.

Then at a meeting on conventional forces in Europe, Secretary of State James A. Baker III announced that there will be a meeting of governments, and chemical industry representatives to explore ways of halting the international trade in chemical weapons precursors and technology. Organized by Australia, the meeting is expected to be held in late fall in Sydney, says Kyle B. Olson, chemical warfare expert for the Chemical Manufacturers Association.

CMA is helping the State Department compile "a list of appropriate industry people throughout the worldwide chemical industry," Olson says. The trade group is also developing a series of measures to help chemical firms deal with the

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CHEMICAL & ENGINEERING

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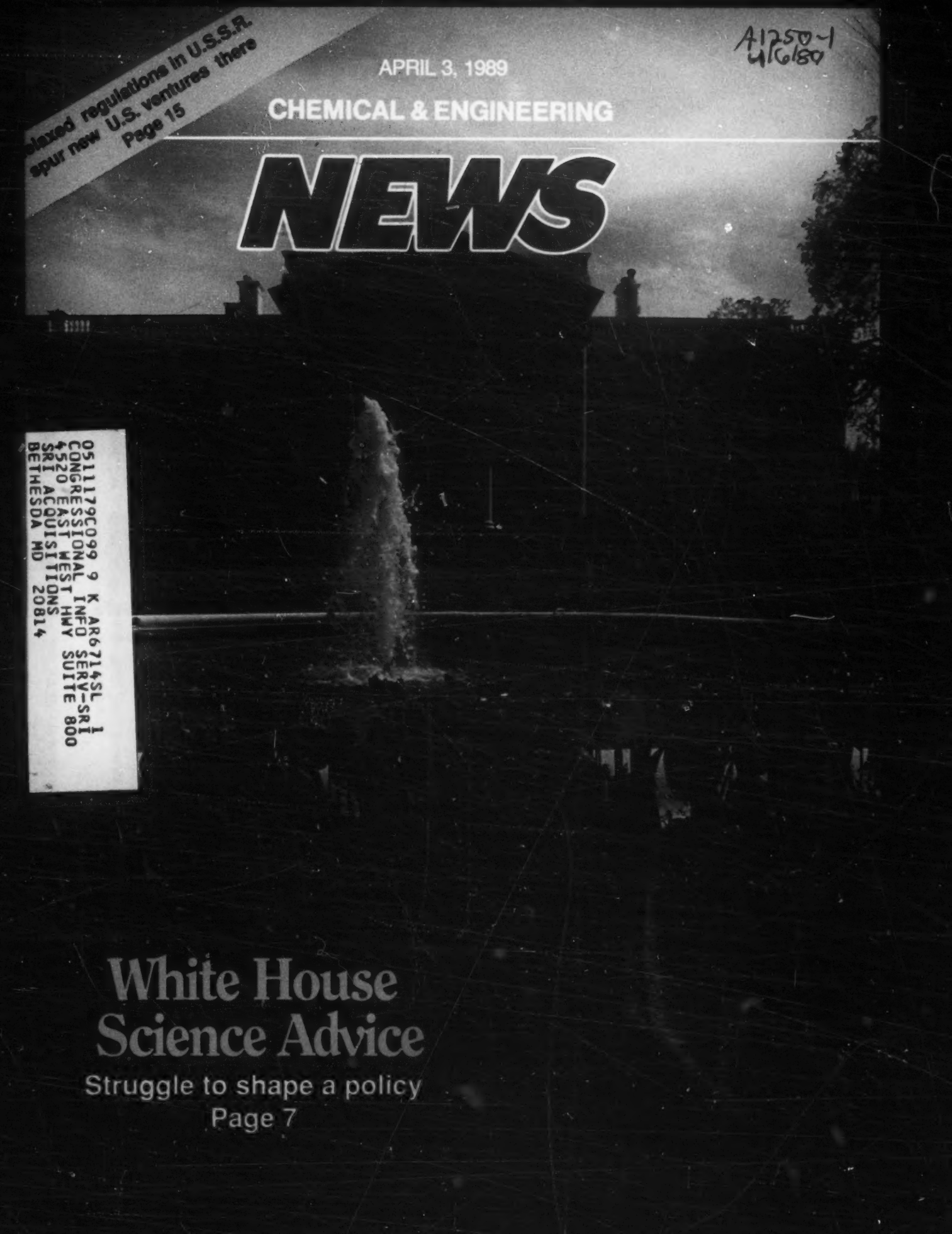

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LETTERS

Energy consumption

SIR: In reference to Joseph A. Counsil's letter (C&EN, Jan. 30, page 2), there are other, major problems regarding the relationship between energy consumption and economic activity in an increasingly service-oriented economy.

However flawed older energy consumption statistics may be, we tend to ignore the importance of fuel wood and animal fodder in the 19th and early 20th centuries. John Fisher has presented these data usefully in his "Energy Crises in Perspective" [Wiley, New York (1974)].

Over the years we have come to measure energy consumption with increasing accuracy and to place commensurate confidence in government statistics on some energy subjects. However, as those who study economic activity have observed, no such confidence is warranted when discussing the gross national product. Thus measures of ratios between energy use and gross national product should be regarded as suspect; this was first emphasized by Peter Gutman ("The Subterranean Economy," *Financial Analysts Journal*, November/December 1977). Gutman later believed that real economic activity exceeded official gross national product 14%. (The overwhelming portion of the underground economy consists of otherwise licit behavior and is not much affected by the level of criminal enterprises.) Edgar Feige, who set out to disprove Gutman ("How Big Is the Irregular Economy?" *Challenge*, November/December 1979, page 5), now thinks that Gutman systematically underestimates the off-the-books economy by a factor of two thirds (*Business Week*, April 5, 1982, page 64).

But Gutman and Feige do agree that in the U.S., as elsewhere, the level of underground economic activity has increased sharply in recent decades—both absolutely and as a percentage of officially reported gross national product. The effect is to understate the energy efficiency of the U.S. and other economies and to do so more each year.

There are several reasons why this is so. The economy is shifting to those sectors where income is more easily disguised. High marginal tax rates foster tax evasion. And both the complexity of taxation and the frequency of tax reform—which adds a lottery component to U.S. taxation—make it costly or even impossible to minimize the expenses of legal compliance.

The U.S. chemical industry, among others, is disadvantaged by the lack of predictability of future tax rates. Since taxation is a major determinant of income, repeated efforts to reform tax policy increases the investment uncertainty for U.S. industries relative to that of their foreign competitors.

E. R. Habicht Jr.
Port Jefferson, N.Y.

Changing public perception

SIR: "Chemical dependency" is rapidly becoming the accepted newspaper euphemism for drug, alcohol, and tobacco addiction. This unhappy usage adds to the existing negative connotations for chemistry and chemicals from such word combinations as "chemical wastes," "hazardous chemicals," and, of course, "chemical warfare."

It is evident that chemistry does not have a good public image these days. The common word linkages noted above are not doing much to improve that image. At least in the instance of the phrase chemical dependency, chemists ought to be active in pointing out that such usage is not only inaccurate but possibly harmful.

We are, of course, all addicted to chemicals, the vast majority of which are essential to life. Individuals who are addicted to drugs, alcohol, and so on are not benefited by attempts to soften the impact of their problems by employing words to describe them that are believed more socially acceptable. In fact, such usage may be injurious by delaying acceptance that a serious problem exists.

In the longer run, chemists should make a strong public case for the many positive contributions that chemistry and chemicals have made and upon which our modern society depends for agriculture, housing, health, clothing, and transportation. Changing a public perception is difficult but by no means impossible. (Note that in only a few years the image of Japanese-made articles went from "junk" to "high quality.") Cleaning up waste dumps is only one problem that faces the chemical industry today. Cleaning up its image may be equally daunting, but all chemists can and should participate by seeking to educate their fellow citizens. Start with the elimination of the phrase chemical dependency.

D. J. Berets
Stamford, Conn.

Correction

• March 20, page 44: Photo shows Prolabo Microdigest A300 automatic digester, not the Prolabo Maxidigest as was intended.

Soviet Loosening of Regulations Paves Way to U.S. Ventures There

Chemically related ventures aim to increase exports, hard currency, consumer goods, decrease imports, and enhance technological abilities

Ann M. Thayer,
C&EN Northeast News Bureau

One part of the Soviet Union's current perestroika, or restructuring, policy is aimed at overcoming deficiencies in the technological and industrial base of the Soviet economy. New government policies are de-emphasizing state central planning and are loosening the bureaucratic controls that have nearly paralyzed Soviet industry. The upshot is that as of April 1, it is easier for foreign companies to do business in the Soviet Union.

Modernization and "chemicalization" of Soviet industry are important aspects of the economic reforms (C&EN, Jan. 18, 1988, page 28). Before perestroika, the Soviets tried unsuccessfully to build up their chemical industry through the licensing of technologies and purchases of equipment and turnkey plants from outside the U.S.S.R. But, rather than decreasing their need for imported goods, they created a secondary dependence on foreign equipment imports. Delays as long as 10 to 15 years in construction and operations have left the Soviets with an outdated and ineffective chemical industry.

Although the Soviets manage to be leading producers of fertilizers, rubber, and ammonia, they rely heavily on imported chemicals. The chemical production they have depends heavily on foreign technologies. For example, as much as 90% or more of polyethylene and polypropylene production, and 50% or more of polyvinyl chloride and polystyrene production is on imported equipment. As worldwide prices of oil have dropped, their supply of hard currency from petroleum exports has all but dried up.

Eades: a tremendous opportunity

With the desire to increase exports, hard currency revenues, and domestic supplies of consumer goods, while decreasing dependence on imports and enhancing their technological and managerial abilities, the Soviets are expanding the role that foreign investors can play. The Soviets are looking for progress through developing joint ventures with foreign companies in the Soviet Union. This month, the most recent changes in the joint venture laws become effective.

The joint ventures are aimed at Soviet efforts to emphasize the production of plastics, petrochemicals, fibers, plant protection agents, and pharmaceuticals. PlanEcon Inc., a Washington, D.C.-based research firm that follows the Soviet economy, indicates that the pace of joint ventures has picked up dramatically since the Soviet Joint Venture Decree of January 1987. There were 23 joint ventures with foreign partners at the end of 1987. By the end of January 1989, only two years after the original decree, 205 ventures had been established. At this rate, says Jan Vanous, research director at PlanEcon, the share of joint ventures in the Soviet economy will reach 60% by 1995.

Nearly 80% of the ventures are with western countries. Whereas Finland, Austria, and West Germany account for 42% of the total number, the West Germans and Italians have invested the most money. About 18%, or $80 million, of the total investment in joint ventures is in about a dozen petrochemical or chemical ventures registered by the end of 1988. The average investment in the chemical sector is about $7.3 million.

Many of the earliest ventures are working toward modernizing existing facilities. A joint venture called STERCH was formed in 1988 between Honeywell and the Ministry of Mineral Fertilizer Production to provide process control systems. Honeywell's Austrian subsidiary owns 49% of the venture and contributes the systems and management expertise. STERCH recently completed a $2.2 million contract awarded last year as part of a pilot program to launch the venture. This year STERCH has been awarded three contracts, totaling $8 million, for the upgrading of ammonia fertilizer manufacturing units. Similarly, Combustion Engineering Inc. joined with the Ministry of Oil Re-

fining & Petrochemical Industry in late 1987 to provide control systems and instrumentation for the chemical processing industries.

Combustion Engineering also heads a consortium of McDermott International, Mitsui Co., and Mitsubishi Corp. to construct two petrochemical complexes with the oil ministry in Surgut and Tobolsk in Western Siberia. Feasibility studies are under way and the cost of the projects is estimated at $20 billion. Reportedly, Combustion Engineering is involved with a Japanese consortium that consists of Mitsubishi, Mitsui, and Chiyoda Corp. working with the Ministry of the Chemical Industry to build a petrochemicals facility near Nizhnevartovsk. This facility is estimated to cost $5 billion to $6 billion. Western Siberia has been targeted as the location of several major projects because the region has enormous reserves of oil and natural gas.

Occidental Petroleum Corp., as part of an international consortium including Enimont of Italy, and Marubeni Corp. of Japan, signed a letter of intent with the oil ministry in March 1988. The consortium will build a $6 billion petrochemicals complex in Tengiz near the Caspian Sea to produce sulfur, ethylene, propylene, polyethylene, polypropylene, and other associated products. The consortium has a 49% ownership in the venture.

Because Tengiz is a grass-roots facility, the Soviet partner is not a private company but a government ministry, which, under the reorganized Soviet trade laws, can deal directly with foreign partners. "It's been a long process," says J. Roger Hirl, president and chief operating officer of Occidental Chemical Corp., who has participated in the negotiations with the Soviets. "After the Ministry of Foreign Trade was disbanded, the other ministries did not have the expertise in world business. They have been in a learning process, which exacerbates the difficulties in dealing with them."

Since the joint ventures are being used as a means to learn about western business practices, economics, and technology, the Soviets are often accused of being disorganized and ill-prepared for negotiating. "I don't know whether it's the system or the desire to build 30 major projects in a short time frame," says Hirl. "Their appetite far exceeds their abilities. They want to get from point A to point B in about 10% of the time it really takes to get there." And it's still too early to tell if the trade-off between working with an immense, centralized bureaucracy or with disjunct and, currently, inexperienced units is for the better.

Hirl: dealing has been long process

But, despite the difficulties, there are overriding incentives to doing business in the Soviet Union. Among these are a foothold in the potentially enormous Soviet marketplace, and access to abundant and relatively low-cost raw materials. "Supplies of raw materials are not a concern," says Hirl, "but the ability to get the finished product out of the Soviet Union and be competitive in world markets is." Tengiz is reportedly an inhospitable location with poor access by roads or rail, and little, if any, infrastructure to support industry. Concern is often expressed over the lack of support services because uninterrupted sources of energy, materials, and transportation are not to be taken for granted in the Soviet Union.

A feasibility study for Tengiz has been submitted to the Soviets for review and the outcome is expected any day. As part of the agreement, no less than 50% of the products are to be exported to help ensure the foreign partners of their profits in hard currency. Hirl believes that the increase in Soviet exports will not have a significant effect on world markets. "By the time the plants are on stream," he says, "it's our opinion that the market areas, being Western Europe, Latin America, and the Far East, will have developed to the point where the capacity will be absorbed in the marketplace."

Occidental Petroleum is also part of a project with the Ministry of the Chemical Industry to construct and operate two plants at the Kalush Petrochemical facility in the Soviet Ukraine. The $160 million to $200 million project is awaiting final approval by the Soviets. If the license is granted in the second quarter of this year as expected, it will take about two years to complete the project. The two plants will produce about 100 million lb each of PVC, with 25% percent of the output to be exported.

The experiences of Huntsman Chemical Corp. illustrate some different aspects of dealing with the Soviets under the joint venture laws. Huntsman, a producer of polystyrene, has formed a joint venture with AeroMar to produce plastic food service products. AeroMar itself is a new airline catering joint venture between Marriot Corp. and Aeroflot, the Soviet airline.

Huntsman was prompted to file an application for majority ownership after an announcement of the recent changes in the Soviet law. The change resulted from concern that the former limit of 49% ownership by the foreign partner was an impediment, especially in ventures with multiple partners. Ownership, as defined for a Soviet joint venture, has a catch. Although the foreign partner may own a 99% share and provide most of the capital, the managing board need not reflect the share ownership, and the Soviets are requiring that decisions on fundamental issues be unanimous.

This necessitates negotiating a very detailed agreement. Huntsman is dealing directly with the Soviet company, also only recently allowed, and finds them eager to learn about western business practices during the process. "I feel as comfortable with the people that I am

Soviets set up framework for joint ventures

The Soviet Joint Venture Decree of January 1987 outlines provisions for the operation of joint ventures with foreign partners. To address issues that arose in the past two years, and to make joint ventures more attractive, two supplemental decrees have been made, one in September 1987 and one in December 1988. Here, in brief, are descriptions of the major elements of the joint-venture laws.

Establishment. Three phases of development for the venture are defined: preliminary discussions leading to a letter of intent, negotiations encompassing a feasibility study and construction of the joint-venture agreement, and approval and registration of the venture with the Soviet authorities. For the venture to survive, its charter and activities must, in some sense, satisfy goals set by the Soviets for their economic system.

The decree presents only a basic framework and directs the partners to construct a comprehensive and detailed final agreement. The agreement must specify all structural and operational aspects of the joint venture, including such items as the nature of the business; its objectives, ownership, layout, management, accounting and operating policies; conditions for the sharing of profits, protection of property, resolution of disputes, termination of business, funding, and contributions by the partners.

Ownership. A limit of 49% ownership by the foreign partners, as determined by their contribution to the venture fund, has been changed in the December decree to allow for a majority ownership of anything less than 100%. But the Soviets have added the condition that all "fundamental issues" must be decided unanimously. The partners can specify in the contract those issues considered fundamental.

Capitalization. Contributions to the venture fund can consist of buildings, equipment, land and natural resource rights, cash and other assets, and technological and managerial expertise. The value of these contributions must be assessed with regard to "world market prices." This assessment was to be made in rubles, but the September decree provided an option to have the valuation based on foreign currencies.

Management and operations. A venture will be managed by a board consisting of members from all partners, but representation on the board need not relate to the percentage ownership. The organization, powers, and responsibilities of the board are determined by negotiation. Under the December decree, a foreign citizen can be director of the venture. The firm must employ primarily Soviet citizens and comply with Soviet labor laws; however, joint ventures have been extended the rights to hire and fire employees and to set pay and incentives.

Buying and selling. Joint ventures may buy and sell on the Soviet market either directly or through a government trade organization using either rubles or hard currency. The foreign trade system in the Soviet Union has recently been reorganized, with individual ministries being given more control. The December decree has extended these rights even further allowing Soviet enterprises to engage directly in foreign trade.

Profits and taxes. The foreign partner shares in the profits of the venture in proportion to the percentage ownership. Profits will be taxed at a level of 30% after a two-year tax holiday that begins when the venture declares a profit. Foreign partners can transfer profits out of the Soviet Union in hard currency but these will be taxed an additional 20%. An important stipulation of the decree requires that "all foreign currency expenditures of a joint venture, including the transfer of profits and other sums due foreign partners, ... shall be covered by proceeds from sales of the joint venture's products on foreign markets." Thus the venture must be self-sufficient in terms of available hard currency. The ability of the foreign partner to obtain hard currency directly is also tied to export sales.

Other more general, yet significant, changes in the Soviet economy affecting joint ventures are mentioned in the December decree. A new exchange rate for the ruble is expected in January 1991. In the meantime, the ruble will be devalued 50% as of January 1990. The decree also directs Soviet authorities to complete a study by the first quarter of 1989 and make proposals for the convertibility of the ruble. Tax breaks and other privileges also may be granted to promote ventures in the far eastern economic area of the Soviet Union.

dealing with as I've felt with any western country or company," says Michael C. Eades, Huntsman vice president of corporate development and manager of the Soviet project. "We have no reason to doubt that they're not going to perform in all the categories that we've negotiated."

Still, as with any business, there will be risks. For businesses in the Soviet Union, assessing those risks may be more difficult because of uncertainties arising from transitions in the economic system. Some believe that risks in the Soviet Union are higher than elsewhere, others disagree or at least accept those risks. "We would not do business unless we could project some type of return," says Eades. "There is tremendous opportunity for any company that wants to do business over there, but they're going to have to be very well capitalized, very patient, and not expect immediate return." He also cautions that the level of return is not so identifiable as with western ventures.

"The long-term return is as advantageous as anything else that one could possibly consider doing anywhere in the world," he comments. "The market for consumer items is just tremendous, you cannot satisfy the need, you cannot saturate the market." However, trying to serve only the Soviet domestic market can present tremendous obstacles. One conflict is between the Soviets' desire to produce products for export, and the foreign partners' interest in selling to the large Soviet market. Foreign partners will not be interested in exporting to an already well-serviced world market.

A stipulation in the joint venture decree adds to this dilemma. It re-

Finland has most Soviet joint ventures . . .

	Number of ventures
Finland	28
Austria	26
West Germany	26
Italy	14
U.S.	13
Switzerland	10
U.K.	9
Hungary	8
France	8
Japan	8
Canada	6
Other	35
TOTAL[a]	191

. . . but West Germany invests more

	$ Millions
West Germany	$ 66
Italy	62
Yugoslavia	43
France	43
Finland	35
Austria	35
Switzerland	33
Japan	30
U.S.	23
Canada	17
Sweden	13
Other	41
TOTAL[b]	$441

a As of Dec. 31, 1988. b As of Dec. 29, 1988. Source: PlanEcon Inc.

quires that all hard currency expenditures of the venture, including payments of profits to the foreign partner, result from export sales. This would suggest that the Soviets' stated goal of taking care of domestic needs is secondary to their desire to ensure themselves of an export market to earn hard currency. This also means that the ventures must be self-supporting—independent of the government subsidies of hard currency frequently granted to Soviet businesses. Under these limitations, exports have apparently become the only direct source of hard currency from the venture for the foreign partners.

Of course, the venture can earn and spend rubles, particularly on its expenses within the U.S.S.R. But rubles are not an exchangeable currency and under the fixed Soviet exchange rate are greatly overvalued. To make trading in the Soviet market realistic, the ruble must be made convertible and prices within the Soviet Union must reflect world market prices.

If the ruble were made convertible, getting one's profits out no longer would be a problem. A change to convertibility could have drastic effects on both the economic balance of a foreign investment and on the Soviet society. "Economists in the Soviet Union are talking about eventual convertibility," explains Peter J. Pettibone, cochairman of the Legal Committee of the U.S.-U.S.S.R. Trade & Economic Council and partner of the New York City-based law firm of Lord Day & Lord, Barrett Smith. "The difficulty is putting it into operation and keeping a lid on the social problems that will undoubtedly result when there are radical price adjustments."

If the ruble is not made convertible in the near future, a means must be devised to get hard currency out of a venture if, as in the case of AeroMar, it does not have a large export market and a large proportion of its profits are in rubles. One option is an exchange auction that was proposed by the Soviets on an experimental basis this year, but may be postponed. Hard currencies and rubles, at a rate that may differ from the fixed Soviet rate, can be bought and sold at currency exchange auctions. "Even so," says Pettibone, "there is considerable doubt as to whether joint ventures are going to be allowed to participate or, if they are allowed, joint ventures may only be allowed to sell hard currency."

The foreign partner may wish to take its profits in raw materials or products, an approach that has great potential in the petrochemical industry. But during a recession, this can cause a glut on the world market as happened in barter deals in the early 1980s. Another possibility is to take advantage of the freedom granted joint ventures to buy and sell goods in the Soviet market for either rubles or foreign currencies. Sales of products from a venture could be made, either all or in part, for hard currencies completely within the Soviet Union. However, a venture may be forced to spend hard currency when a supplier asks for the same conditions.

Despite these major obstacles, such as the exchangeability of the ruble and hard currency issues, there is generally a good amount of optimism, tempered with caution, about setting up joint ventures in the Soviet Union. Optimism stems, to a large extent, from the willingness of the Soviets to educate themselves in the areas of western economics and business, and their desire to make technological advances. As the Soviets move farther along their learning curve, more companies are exercising the freedom to participate in joint ventures, negotiations are becoming easier, and the attitudes toward joint ventures are becoming more positive. An attitude expressed by both the U.S. and Soviet sides is that the atmosphere for trade will improve further if laws linking favorable trading status to human rights issues are either waved by the U.S. government or their conditions satisfied by the Soviets.

U.S. partners in joint ventures, such as Huntsman and Occidental Petroleum, report that they have not faced serious obstacles to doing business from the U.S. side. To export some technologies to the Soviet Union, a license may be needed from the U.S. Department of Commerce. Although Commerce is said to be speeding up the processing of licenses, it still may take a few months to obtain approval. Limitations are expected primarily in technologies that involve computerization, highly pure chemicals for electronics, and chemicals related to warfare or nuclear weapons. However, seemingly harmless products may also be restricted because of the embodied technology. Petrochemical and chemical ventures often do not involve strategic technologies.

The probability for success in petrochemical and chemical joint ventures is quoted as being very high. "It's difficult to do wrong," says Vanous of PlanEcon. He attributes this to the Soviets' very much needed boom in growth, the abundant supplies of natural resources, and the low labor requirements in the chemical industry. □

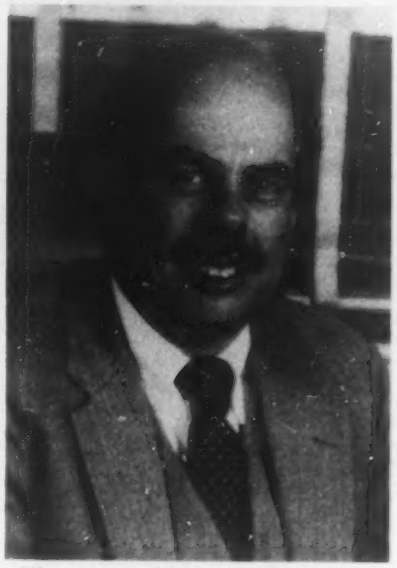
Tougher laws on toxic emissions urged

Citing preliminary data from the Environmental Protection Agency's toxic chemical emissions inventory, several Congressmen are calling for increased regulations on the release of allegedly toxic chemicals by industry. In response, chemical industry representatives say they are already well on their way to reducing pollution and that intimating health problems from current emissions is wrong.

In a short report based on data supplied by EPA, the House Subcommittee on Health & the Environment says that, according to industry estimates, 2.4 billion lb of toxic chemicals are released into the air annually. About one third of that, 887 million lb, comes from the chemical industry. Subcommittee chairman Henry A. Waxman (D.-Calif.), a longtime advocate of stricter federal regulation of air emissions for the chemical industry, says: "The magnitude of the problem far exceeds our worst fears. It is essential that we have a strong and effective air toxics program as part of the Clean Air Act amendments that will be moving through Congress this year." He, along with Rep. Mickey Leland (D.-Tex.), Rep. Gerry Sikorski (D.-Minn.), and Rep. James Florio (D.-N.J.), plans to introduce legislation that would bring further controls to chemical emissions soon.

Waxman makes the jump from the emissions inventory to the impact these emissions have on people's health. "Such high levels of toxic releases are sure to be accompanied by comparably high levels of human suffering," he says. Waxman cites studies that show higher-than-average cancer incidence near chemical facilities and subcommittee testimony from individuals who relate their personal health problems to their proximity to a chemical plant. Florio agrees and blames delays by EPA for putting people at risk.

"My fear is that people are facing very serious health risks," Florio says. "EPA intends to spend upwards of $400,000 during fiscal 1989 on so-called risk communication strategies designed to convince the public that these releases are of minimal concern. I wonder why these dollars weren't spent to establish much-needed standards for the carcinogens and neurotoxins [listed] in this report."



Waxman: problem exceeds our fears

The EPA data present emissions on a state-by-state basis and give the total emissions of each of the listed chemicals. Some examples are pulled out by the subcommittee to show how serious the problem is. One is the listing of 69,000 lb of phosgene emitted annually. According to EPA, that all seems to come from just one plant in Kansas, and it may have been an accidental release. The agency doesn't know yet. Other examples focus on the relatively large amounts of emissions in the Houston and the Great Lakes areas, where there happen to be large concentrations of chemical industry facilities. The report also pulls out the data on chemicals that the subcommittee says are listed as carcinogens by the U.S. Public Health Service's National Toxicology Program.

Data used by the subcommittee come from a provision in the 1986 Superfund Amendments & Reauthorization Act that is directed toward community right-to-know and emergency preparedness with respect to chemicals. One section of that provision, Section 313, requires that any facility that produces or imports certain volumes of any of more than 320 chemicals that have been designated by Congress as acutely toxic must provide EPA with an estimate of how much of each of these chemicals is emitted into the air at every facility. These inventories of chemical releases during 1987 were due to EPA on July 1 last year. At that time EPA expected nearly 300,000 reports from 30,000 facilities. That expectation has been lowered now that EPA has received only about 75,000 reports from fewer than 17,500 plants so far. EPA estimates these reports are only 55 to 70% of the total number required. Even the total emissions figure (2.4 billion lb) may be a small percentage of the total because it does not include thousands of small companies that emit these chemicals. There is another deadline this July 1 for the second annual inventory. The subcommittee report uses raw data from the first inventory for its conclusions.

Although Waxman singles out the chemical industry as the largest source of these chemicals, the industry does not see itself as part of a great national problem. Randal P. Schumacher, director of health, safety, and environmental programs for the Chemical Manufacturers Asso-

Chemical industry tops list for toxic chemical emissions

Millions of lb	SIC code	Total air emissions
Chemicals	28	886.6
Primary metals	33	215.1
Paper	26	207.9
Transportation equipment	37	192.0
Rubber and plastics	30	132.0
Fabricated metals	34	110.2
Electrical and electronics equipment	36	89.7
Petroleum and coal	29	75.5
Machinery	35	46.2
Furniture and fixtures	25	45.3
Instruments	38	41.6
Textiles	22	34.9
Stone, clay, and glass	32	25.7
Lumber and wood	24	25.0
Miscellaneous manufacturing	39	21.7
Food	20	15.7
Leather	31	7.5
Apparel	23	2.1

Source: Environmental Protection Agency

ciation, says that chemical companies have worked very hard, particularly since the Bhopal, India, disaster, to reduce their chemical emissions and recycle waste more efficiently. Concerning the numbers Waxman released, Schumacher says, "While the numbers are high, they are just estimates. We in the industry were given assumptions to use by EPA when calculating the levels of emissions, especially fugitive emissions, that probably give high numbers." Schumacher says that it must be remembered that the data are for 1987 and that a number of chemical industry programs have already reduced air emissions substantially.

Both CMA and EPA are concerned about the subcommittee's contentions that the listed emissions cause disease. Schumacher says it most strongly: "The allegations between the raw data and health effects are wrong. There are no data to support it and it just serves to frighten people. It is just bad government and bad use of resources."

Susan Bullard of EPA's Congressional Liaison Office agrees: "There is no question that there are a lot of toxic chemicals in the air, but we can't say that any of this equates to any particular risk to the public. The public, too, doesn't care about chemical-by-chemical release data. They want to know what it all means." But that is going to take a while to figure out, she adds.

Waxman and his colleagues point out that the Clean Air Act has a toxic chemical provision, Section 112, but EPA has only issued regulations on seven substances (beryllium, mercury, vinyl chloride, asbestos, benzene, radionuclides, and arsenic) and has often reneged on regulating many others. Waxman says his new legislation "will list hazardous air pollutants and mandate that sources of these pollutants use all the technology available to reduce their emissions and protect the public health." It will include provisions to prevent accidental releases of the listed chemicals and require that sources of these chemicals take precautions "so that we can halt the unending series of chemical accidents."

David Hanson

Technologies vital to U.S. defense selected

Concerned that the U.S. is losing its edge in technologies vital for national defense, Congress last September ordered the Department of Defense, in consultation with the Department of Energy, to draw up a Critical Technologies Plan by March 15 each year. The report is to list the 20 technologies deemed "most essential to develop in order to ensure the long-term qualitative superiority of U.S. weapon systems."

Responding to this mandate, DOD has submitted its first annual report to the House and Senate Armed Services committees. The report was released at a Senate hearing in mid-March before the Subcommittee on Defense Industry & Technology, chaired by Sen. Jeff Bingaman (D.-N.M.), initiator of the mandate. In addition, the Pentagon will submit a classified addendum this month amplifying on "sensitive" aspects of the technologies chosen.

The report lists not 20, but 22 technologies. Among those chemically related are preparation of gallium arsenide (GaAs) and other compound semiconductors, high-temperature/high-strength/lightweight composite materials, superconductivity, and biotechnology materials and processing.

At the hearing, Bingaman noted that his panel is responsible for ensuring the "long-term underpinnings of our national security strategy, namely our technology and industrial bases." However, the panel has heard "report after report that those underpinnings [are] eroding."

"A good part of that erosion undoubtedly derives from the inadequate overall level of resources we devote to our technology base," Bingaman adds. "Time after time I found myself in the position where technologies that seemed to be on everyone's list of truly critical technologies were severely underfunded in the DOD request."

For each technology, Congress asked DOD to discuss the reasons for its selection; goals for its development; current funding by DOD, DOE, and other agencies; and its comparative status in the U.S., Soviet Union, and other nations. The report outlines potential contributions by U.S. allies to the technology's development, and progress the private sector may make with its own resources to develop civilian applications. In making up the list, equal consideration was given to process and product technologies, in light of inadequate DOD efforts until now in process and manufacturing R&D.

Report lists 22 crucial technologies

- Microelectronic circuits and their fabrication
- Preparation of gallium arsenide, other compound semiconductors
- Software producibility
- Parallel processing computer architectures
- Machine intelligence/robotics
- Simulation, modeling with computers
- Integrated optics (optical memories, signal and data processing)
- Fiber optics
- Sensitive radars (counter-Stealth technology)
- Passive sensors
- Automatic target recognition
- Phased arrays (radar, underwater acoustic, and others)
- Data fusion (machine integration and/or interpretation of data, presentation in convenient form for human operators)
- Signature control (reduction of radar, optical, acoustic, or other "signatures" of planes, ships, tanks, other weapons systems)
- Computational fluid dynamics (computer simulation)
- Air breathing propulsion (for air, land, water propulsion)
- High-power microwaves (for weapons use)
- Pulsed power (lightweight, compact sources for laser- or microwave-directed energy weapons)
- Hypervelocity projectiles
- High-temperature/high-strength/lightweight composite materials
- Superconductivity
- Biotechnology materials and processing